

# Package ‘rsem’

July 2, 2014

**Type** Package

**Title** Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

**Version** 0.4.5

**Date** 2010-12-27

**Author** Ke-Hai Yuan and Zhiyong Zhang

**Maintainer** Zhiyong Zhang <zhiyongzhang@end.edu>

**Depends** R (>= 2.7), MASS, lavaan

**Description** This package estimates means and covariance matrix of multiple variables with missing data using Huber weight and then estimates a SEM model using lavaan or EQS.

**License** GPL-2

**URL** <http://rpackages.psychstat.org>

**ZipData** no

**LazyLoad** yes

**NeedsCompilation** no

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rsem-package	<i>Robust Structural Equation Modeling with Missing Data and Auxiliary</i>
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## Description

This package estimates means and covariance matrix of multiple variables with missing data using Huber weight and then estimates a SEM model using either lavaan or EQS.

## Details

Package:	rsem
Type:	Package
Version:	0.4.3
Date:	2010-12-27
License:	GPL-2
LazyLoad:	yes

## Author(s)

Ke-Hai Yuan and Zhiyong Zhang Maintainer: Zhiyong Zhang <zhiyongzhang@nd.edu>

## References

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

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mardiamv25	<i>Simulated data</i>
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---

**Description**

mardiamv25: Original data

mardiamv25\_contaminated: Contaminated data with outliers

**Usage**

```
data(mardiamv25)
data(mardiamv25_contaminated)
```

---

rsem	<i>The main function for robust SEM analysis</i>
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---

**Description**

This is the function to carry out all analysis.

**Usage**

```
rsem(dset, select, EQSmodel, moment=TRUE, varphi=.1, st='i', max.it=1000,
eqsdata='data.txt', eqsweight='weight.txt', EQSpgm="C:/Progra~1/EQS61/WINEQS.EXE",
serial="1234")
```

**Arguments**

dset	A data matrix or a data frame
select	Variables to be selected for SEM analysis. If omitted, all variables in the data set will be used.
moment	With mean structure. For covariance only, set moment=FALSE.
EQSmodel	The input file for EQS. If omitted, only the first-stage analysis will be conducted.
varphi	Proportion of data to be down-weighted. Default is 0.1.
max.it	Maximum number of iterations for EM. Default is 1000
st	Starting values for EM algorithm. The default is 0 for mean and I for covariance. Alternative, the starting values can be estimated according to MCD.
eqsdata	Data file name used in EQS
eqsweight	File name for weight matrix
EQSpgm	The path to the installed EQS program
serial	The serial no of EQS

**Details**

This function will run the robust analysis and output results.

**Value**

If EQSmodel is not supplied

sem	Information for SEM analysis including estimated means, covariance matrix and their sandwich type covariance matrix in the order of mean first and then covariance matrix.
misinfo	Information related to missing data pattern
em	Results from expectation robust algorithm
ascov	Covariance matrix

If EQSmodel is supplied,

sem	Information for SEM analysis including estimated means, covariance matrix and their sandwich type covariance matrix according to the requirement of EQS.
-----	--

In addition, the following model parameters are from EQS

fit.stat	Fit indices and associated p-values
para	Parameter estimates
eqs	All information from REQS

**Author(s)**

Ke-Hai Yuan and Zhiyong Zhang

**References**

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

**See Also**

[rsem.pattern](#), [rsem.emmusig](#), [rsem.Ascov](#)

**Examples**

```
## Not run:
## an example
## to use eqs, first load the package semdiag
library(semdiag)
data(mardiamv25)
analysis<-rsem(mardiamv25, c(1,2,4,5), 'eqsinput.eqs')

## End(Not run)
```

---

rsem.Ascov	<i>Sandwich-type covariance matrix</i>
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---

### Description

Returns the sandwich type covariance matrix. This function is not intended to use separately from the `rsem.emmusig` function.

### Usage

```
rsem.Ascov(xpattern, musig, varphi=.1)
```

### Arguments

xpattern	Missing data pattern output from <code>rsem.pattern</code> .
musig	Robust mean and covariance matrix from <code>rsem.emmusig</code>
varphi	Proportion of data to be down-weighted. Default is 0.1.

### Details

Data should be a matrix. To change a data frame to a matrix, using `data.matrix(x)`.

### Value

Abeta	A matrix
Bbeta	B matrix
Gamma	Sandwich type covariance matrix

### Author(s)

Ke-Hai Yuan and Zhiyong Zhang

### References

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

### See Also

[rsem.emmusig](#)

**Examples**

```
#dset<-read.table('MardiaMV25.dat.txt', na.string='-99')
#dset<-data.matrix(dset)
#n<-dim(dset)[1]
#p<-dim(dset)[2]
#miss_pattern<-rsem.pattern(n,p,dset)
#misinfo<-miss_pattern$misinfo
#V_forana<-c(1,2,4,5)
#em_results<-rsem.emmusig(dset,misinfo)
#hmu1<-em_results$mu
#hsigma1<-em_results$sigma
#rsem.Ascov(x, hmu1, hsigma1)
```

---

rsem.DP

*Generate a duplication matrix*

---

**Description**

Generate a duplication matrix

**Usage**

```
rsem.DP(x)
```

**Arguments**

x                    A matrix

**Author(s)**

Ke-Hai Yuan and Zhiyong Zhang

**References**

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

**Examples**

```
x<-array(1:6, c(2,3))
rsem.DP(x)
```

---

`rsem.emmusig`*Robust mean and covariance matrix using Huber-type weight*

---

**Description**

Robust mean and covariance matrix using Huber-type weight.

**Usage**

```
rsem.emmusig(xpattern, varphi=.1, max.it=1000, st='i')
```

**Arguments**

<code>xpattern</code>	Missing data pattern output from <code>rsem.pattern</code> .
<code>varphi</code>	Proportion of data to be down-weighted. Default is 0.1.
<code>max.it</code>	Maximum number of iterations for EM. Default is 1000
<code>st</code>	Starting values for EM algorithm. The default is 0 for mean and I for covariance. Alternative, the starting values can be estimated according to MCD.

**Details**

Estimate mean and covariance matrix using the expectation robust (ER) algorithm.

**Value**

<code>err</code>	Error code. 0: good. 1: maximum iterations are exceeded.
<code>mu</code>	Mean vector
<code>sigma</code>	Covariance matrix

**Author(s)**

Ke-Hai Yuan and Zhiyong Zhang

**References**

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

**See Also**

[rsem.emmusig](#)

## Examples

```
#dset<-read.table('MardiaMV25.dat.txt', na.string='-99')
#dset<-data.matrix(dset)
#n<-dim(dset)[1]
#p<-dim(dset)[2]
#miss_pattern<-rsem.pattern(n,p,dset)
#misinfo<-miss_pattern$misinfo
#V_forana<-c(1,2,4,5)
#em_results<-rsem.emmusig(dset,misinfo)
#em_results
```

---

rsem.fit

*Calculate robust test statistics*

---

## Description

Calculate robust test statistics

## Usage

```
rsem.fit(object, gamma, musig)
```

## Arguments

object	Output from lavaan analysis, such as growth, factor, sem functions.
gamma	Robust covariance matrix for saturated mean and covariances
musig	Robust saturated mean and covariances

## Author(s)

Ke-Hai Yuan and Zhiyong Zhang

## References

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

## Examples

```
x<-array(1:6, c(2,3))
rsem.vec(x)
```



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rsem.gname	<i>Internal function</i>
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---

**Description**

Internal function

**Usage**

```
rsem.gname(name)
```

**Arguments**

name	Variable names.
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**Author(s)**

Ke-Hai Yuan and Zhiyong Zhang

**References**

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

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rsem.index	<i>rsem.index function</i>
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**Description**

To be added

**Usage**

```
rsem.index(p, oj)
```

**Arguments**

p	number of variables
oj	observed variables

---

rsem.indexv	<i>rsem.indexv function</i>
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---

**Description**

Internal function.

**Usage**

```
rsem.indexv(p, select)
```

**Arguments**

p	number of variables
select	variables to be used

---

rsem.indexvc	<i>rsem.indexvc function</i>
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---

**Description**

Internal function.

**Usage**

```
rsem.indexvc(p, select)
```

**Arguments**

p	number of variables
select	variables to be used

---

rsem.pattern	<i>Obtaining missing data patterns</i>
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---

### Description

This function obtains the missing data patterns and the number of cases in each patterns. It also tells the number of observed variables and their indices for each pattern.

### Usage

```
rsem.pattern(x, print=FALSE)
```

### Arguments

x	A matrix as data
print	Whether to print the missing data pattern. The default is FALSE.

### Details

The missing data pattern matrix has 2+p columns. The first column is the number cases in that pattern. The second column is the number of observed variables. The last p columns are a matrix with 1 denoting observed data and 0 denoting missing data.

### Value

x	Data ordered according to missing data pattern
misinfo	Missing data pattern matrix
mispat	Missing data pattern in better readable form.

### Author(s)

Ke-Hai Yuan and Zhiyong Zhang

### References

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

### Examples

```
#dset<-read.table('MardiaMV25.dat.txt', na.string='-99')
#dset<-data.matrix(dset)
#n<-dim(dset)[1]
#p<-dim(dset)[2]
#miss_pattern<-rsem.pattern(n,p,dset)
#miss_pattern
```

---

 rsem.print

*Organize the output for Lavaan with robust s.e. and test statistics*


---

### Description

Organize the output for Lavaan with robust s.e. and test statistics. Modified from the print function of Lavaan.

### Usage

```
rsem.print(object, robust.se, robust.fit, estimates=TRUE, fit.measures=FALSE,
standardized=FALSE, rsquare=FALSE, std.nox=FALSE, modindices=FALSE)
```

### Arguments

object	Output from lavaan analysis, such as growth, factor, sem functions.
robust.se	Robust standard error from the function rsem.se
robust.fit	Robust fit statistics from the function rsem.fit
estimates	Show parameter estimates
fit.measures	Show fit statistics of lavaan (no need for it)
standardized	standardized coefficients
rsquare	R square for dependent variables.
std.nox	to add
modindices	Modification indices

### Details

This function will run the robust analysis and output results.

### Value

If EQSmodel is not supplied

sem	Information for SEM analysis including estimated means, covariance matrix and their sandwich type covariance matrix in the order of mean first and then covariance matrix.
misinfo	Information related to missing data pattern
em	Results from expectation robust algorithm
ascov	Covariance matrix

If EQSmodel is supplied,

sem	Information for SEM analysis including estimated means, covariance matrix and their sandwich type covariance matrix according to the requirement of EQS.
-----	--

In addition, the following model parameters are from EQS

fit.stat	Fit indices and associated p-values
para	Parameter estimates
eqs	All information from REQS

### Author(s)

Ke-Hai Yuan and Zhiyong Zhang

### References

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

### See Also

[rsem.pattern](#), [rsem.emmusig](#), [rsem.Ascov](#)

### Examples

```
##\dontrun{
## an example
data(mardiamv25)
names(mardiamv25)<-paste('V', 1:5, sep='')

fa.model<-'f1 =~ V1 + V2
f2 =~ V4 + V5
f1 ~ 1
f2 ~ 1
V1 ~0*1
V2 ~0*1
V4 ~0*1
V5 ~0*1'

pat<-rsem.pattern(mardiamv25)

phi<-0.1
musig<-rsem.emmusig(pat, varphi=phi)

res.lavaan<-sem(fa.model, sample.cov=musig$sigma, sample.mean=musig$mu, sample.nobs=88,mimic='EQS')

ascov<-rsem.Ascov(pat, musig, varphi=phi)

robust.se<-rsem.se(res.lavaan, ascov$Gamma)

robust.fit <- rsem.fit(res.lavaan, ascov$Gamma, musig)

rsem.print(res.lavaan, robust.se, robust.fit)
## }
```

---

rsem.se	<i>Calculate robust standard errors</i>
---------	---

---

**Description**

Calculate robust standard errors

**Usage**

```
rsem.se(object, gamma)
```

**Arguments**

object	Output from lavaan analysis, such as growth, factor, sem functions.
gamma	Robust covariance matrix for saturated mean and covariances

**Author(s)**

Ke-Hai Yuan and Zhiyong Zhang

**References**

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

**Examples**

```
x<-array(1:6, c(2,3))  
rsem.vec(x)
```

---

rsem.ssq	<i>Calculate the squared sum of a matrix</i>
----------	--

---

**Description**

Calculate the squared sum of a matrix

**Usage**

```
rsem.ssq(x)
```

**Arguments**

x	A matrix
---	----------

**Author(s)**

Ke-Hai Yuan and Zhiyong Zhang

**References**

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

**Examples**

```
x<-array(1:6, c(2,3))
rsem.ssq(x)
```

---

rsem.switch	<i>swith function</i>
-------------	-----------------------

---

**Description**

swith function

**Usage**

```
rsem.switch(p)
```

**Arguments**

p	number of variables
---	---------------------

---

rsem.switch.gamma	<i>Internal function</i>
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---

**Description**

Internal function

**Usage**

```
rsem.switch.gamma(gamma, ov.names)
```

**Arguments**

gamma	Robust covariance matrix for saturated mean and covariances
ov.names	Observed variable names.

**Author(s)**

Ke-Hai Yuan and Zhiyong Zhang

**References**

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

---

rsem.vec

*Stacking a matrix to a vector*

---

**Description**

Stacking a matrix to a vector

**Usage**

```
rsem.vec(x)
```

**Arguments**

x                    A matrix

**Author(s)**

Ke-Hai Yuan and Zhiyong Zhang

**References**

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

**Examples**

```
x<-array(1:6, c(2,3))  
rsem.vec(x)
```



---

rsem.vech	<i>Stacking lower triange of a matrix to a vector</i>
-----------	---

---

**Description**

Stacking lower triange of a matrix to a vector

**Usage**

```
rsem.vech(x)
```

**Arguments**

x	A matrix
---	----------

**Author(s)**

Ke-Hai Yuan and Zhiyong Zhang

**References**

Ke-Hai Yuan and Zhiyong Zhang (2011) Robust Structural Equation Modeling with Missing Data and Auxiliary Variables

**Examples**

```
x<-array(1:9, c(3,3))
rsem.vec(x)
```

---

rsem.weight	<i>Calculate weight for each subject</i>
-------------	--

---

**Description**

Calculate weight for each subject in estimating the mean and covariance matrix.

**Usage**

```
rsem.weight(x, varphi, mu0, sig0)
```

**Arguments**

x	Data
varphi	Downweight rate.
mu0	Robust mean
sig0	Robust covariance matrix.

**Value**

w1	Weight for robust mean estimates
w2	Weight for robust covariance estimates

**Author(s)**

Zhiyong Zhang and Ke-Hai Yuan

**References**

Yuan, K.-H., & Zhang, Z. (2012). Robust Structural Equation Modeling with Missing Data and Auxiliary Variables. *Psychometrika*, 77(4), 803-826.

---

semdiag.combinations *Enumerate the Combinations of the Elements of a Vector*

---

**Description**

Enumerate the Combinations of the Elements of a Vector

**Usage**

```
semdiag.combinations(n, r)
```

**Arguments**

n	Size of the source vector
r	Size of the target vectors

---

semdiag.read.eqs *Import of EQS outputs into R*

---

**Description**

This function reads EQS output files (.ets, .CBK and .ETP) into R and stores the results as objects.

**Usage**

```
semdiag.read.eqs(file)
```

**Arguments**

file	The name (string) of the .ets file or the full path which the data are to be read from. If it does not contain an absolute path, the file name is relative to the current working directory, 'getwd()'. A .CBK and .ETP file have to be of the same name and in the same directory.
------	---

**Details**

The value list below provides objects for the full EQS output. If in EQS some objects are not computed, the corresponding values in R are NA.

**Value**

Returns a list with the following objects:

model.info	General model information
pval	p-values for various test statistics
fit.indices	Variuos fit indices
model.desc	Descriptive measures
Phi	Phi matrix
Gamma	Gamma matrix
Beta	Beta matrix
par.table	Parameter table (with standard errors)
sample.cov	Sample covariance matrix
sigma.hat	Model covariance matrix
inv.infmat	Inverse information matrix
rinv.infmat	Robust inverse information matrix
cinv.infmat	Corrected inverse information matrix
derivatives	First derivatives
moment4	Matrix with 4th moments
ssolution	Standardized elements
Rsquared	R-squared measures
fac.means	Factor means
var.desc	Descriptive measures for the variables (univariate statistics)
indstd	Independent variable standardization vector
depstd	Dependent variable standardization vector

**Author(s)**

Patrick Mair, Eric Wu

**References**

Bentler, P. M. (2008). EQS Program Manual. Encino, CA: Multivariate Software Inc.

**See Also**

[semdiag.call.eqs](#), [semdiag.run.eqs](#)

---

semdiag.run.eq	<i>Run EQS from R</i>
----------------	-----------------------

---

### Description

Calls an EQS script file from R, executes EQS, and imports the results into R. Basically it is a wrapper function of `call.eq` and the subsequent `read.eq`.

### Usage

```
semdiag.run.eq(EQSpgm, EQSmodel, serial, Rmatrix = NA, datname = NA, LEN = 2000000)
semdiag.call.eq(EQSpgm, EQSmodel, serial, Rmatrix = NA, datname = NA, LEN = 2000000)
```

### Arguments

EQSpgm	String containing path where EQS is located (see details)
EQSmodel	String containing path where .eq script file is located (see details)
serial	EQS serial number as integer value
Rmatrix	Optional matrix argument if data or covariances are stored in R
datname	If data is specified, a filename (string) must be provided for saving the data in text format (blank separated; see details)
LEN	Integer containing number of working array units. By default, it is 2000000 8 bytes units

### Details

If the path in `EQSpgm` and `EQSmodel` contains a blank, single quotes and double quotes are required in argument. See `EQSpgm` argument in examples. The last statement in the `EQSpgm` argument refers to the name of the executable program file. Under Windows it is `".../WINEQS"` (referring to `WINEQS.exe`), under Mac `".../MACEQS"` and under Linux `".../EQS"`. When specifying the path, use slash instead of backslash.

The `.ETS`, `.CBK` and `.ETP` files are written in the directory where the `.eq` file is located. Note that these 3 files must be in the same directory than the `.eq` file.

The argument `datname` must match with the input data specified in the corresponding `.eq` file. This option can be used for simulations: Generate data in R, `run.eq()` on with the corresponding data argument, pick out the relevant return values.

The value list below provides objects for the full EQS output. If in EQS some objects are not computed, the corresponding values in R are `NA`.

### Value

Returns a list with the following objects:

success	TRUE if estimation was successful, FALSE otherwise
model.info	General model information

<code>pval</code>	p-values for various test statistics
<code>fit.indices</code>	Variuos fit indices
<code>model.desc</code>	Descriptive measures
<code>Phi</code>	Phi matrix
<code>Gamma</code>	Gamma matrix
<code>Beta</code>	Beta matrix
<code>par.table</code>	Parameter table (with standard errors)
<code>sample.cov</code>	Sample covariance matrix
<code>sigma.hat</code>	Model covariance matrix
<code>inv.infmat</code>	Inverse information matrix
<code>rinv.infmat</code>	Robust inverse information matrix
<code>cinv.infmat</code>	Corrected inverse information matrix
<code>derivatives</code>	First derivatives
<code>moment4</code>	Matrix with 4th moments
<code>ssolution</code>	Standardized elements
<code>Rsquared</code>	R-squared measures
<code>fac.means</code>	Factor means
<code>var.desc</code>	Descriptive measures for the variables (univariate statistics)
<code>indstd</code>	Independent variable standardization vector
<code>depstd</code>	Dependent variable standardization vector

**Author(s)**

Patrick Mair, Eric Wu

**References**

Bentler, P. M. (1995). EQS Program Manual. Encino, CA: Multivariate Software Inc.

**See Also**

[semdiag.read.eq](#)s, [semdiag.call.eq](#)s

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